BERT WECKHUYSEN

CURRICULUM VITAE and SCIENTIFIC ACCOMPLISHMENTS

Aarschot, Belgium, July 27 1968

- *Full professor of Inorganic Chemistry and Catalysis, Utrecht University*
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- *Researcher ID: D-3742-2009*
- *Elected member of the Royal Dutch Academy of Sciences, European Academy of Science and Royal Flemish Academy of Belgium for Sciences and Arts*

A. Short Resume

Prof. Bert Weckhuysen (49) received his master degree in chemical and agricultural engineering with greatest distinction from Leuven University (Belgium) in 1991. After obtaining his PhD degree from Leuven University with honours (highest degree) in 1995 under the supervision of Prof. Robert Schoonheydt, he worked as a postdoc with Prof. Israel Wachs at Lehigh University (USA) and with Prof. Jack Lunsford at Texas A&M University (USA). From 1997 until 2000 he was a research fellow of the Belgian National Science Foundation. Weckhuysen is since October 1 2000 Full Professor at Utrecht University (The Netherlands). Weckhuysen has been appointed as first Distinguished Professor of the Faculty of Science at Utrecht University as of September 2012. Since January 2018 he has been promoted to Distinguished University Professor at Utrecht University. He was a visiting professor at Leuven University (2000-2005) and Stanford University (USA, 2012); and is currently a visiting professor at Stanford University & SLAC National Accelerator Laboratory (2013-) and University College London (UK, 2014-).

Weckhuysen authored or co-authored ~ 470 publications in peer-reviewed scientific journals with an average number of citations per paper of ~ 41 and a Hirsch index of 76. Weckhuysen is the author of 21 conference proceedings publications, 29 other journal publications and editorial material, 27 book chapters and 10 patents/patent applications.

Furthermore, he is the (co-) editor of three books. He serves/served on the editorial and/or advisory boards of Applied Catalysis A: General, Catalysis Letters, Catalysis Today, Chem, Chemical Society Reviews, ChemCatChem, ChemPhysChem, Faraday Discussions, Journal of Applied Chemistry, Journal of Nanoscience and Nanotechnology, Physical Chemistry Chemical Physics, Topics in Catalysis, Vibrational Spectroscopy, Angewandte Chemie and the Journal of Catalysis.

He obtained prestigious VICI (2002), TOP (2006 and 2011) and Gravitation (2013) grants from the Netherlands Organization for Scientific Research (NWO). In 2012 he has been awarded an ERC Advanced Grant from the European Research Council (ERC). Weckhuysen has received several research awards, including the 2006 Royal Dutch Chemical Society Gold Medal, the 2007 DECHEMA Award from The Max Buchner Research Foundation, the 2009 Netherlands Catalysis and Chemistry Award, the Eminent Visitor Award 2009 of the Catalysis Society of South Africa, the 2011 Paul H. Emmett Award in Fundamental Catalysis of the North American Catalysis Society, the International Catalysis Award 2012 of the International Association of Catalysis Societies, the 2013 Vladimir N. Ipatieff Lectureship in Catalysis from Northwestern University, the 2013 John Bourke Award from the Royal Society of Chemistry, the 2013 Spinoza Award from the Netherlands Organization for Scientific Research, the 2017 Kozo Tanabe Prize in Acid-Base Catalysis from the International Acid-Base Group, the 2017 Xing Da Lectureship of Peking University and the 2018 Robert B. Anderson Award from the Canadian Catalysis Society. In 2015 he has been appointed Knight in the Order of the Netherlands Lion.

Weckhuysen was the scientific director of the Dutch Research School for Catalysis (NIOK) in the period 2003-2013 and of a Smartmix research program Biomass Catalysis funded by the Dutch government and chemical industries (CatchBio; 2007-2016; ~29 M€; www.catchbio.com). Currently, he directs a Gravitation research program on Multiscale Catalytic Energy Conversions (MCEC; 2013-2023; ~32 M€; www.mcec-researchcenter.nl) funded by the Dutch government as well as on Advanced Research Center Chemical Building Blocks Consortium (ARC CBBC; 2016-2026; 11 M€/year, www.arc-cbbc.nl) with a joint investment by government, businesses and universities. He was (one of) the main initiator(s) of these large research program initiatives.

Weckhuysen is an elected member of the Royal Dutch Academy of Sciences (KNAW), Royal Flemish Academy of Belgium for Sciences and Arts (KVAB), the Netherlands

Academy of Technology and Innovation (NATI), the Royal Holland Society of Sciences (KHMW), and the European Academy of Science; an alumnus elected member of the Young Academy (DJA, 2005-2010) of the KNAW; and a fellow of the Royal Society of Chemistry (FRSC), the American Association for Advancement of Science (AAAS) and ChemPubSoc Europe. Weckhuysen serves on many boards and panels for national and international research.

B. Publication Track Record

- Hirsch-index of 76 (based on 25 years of research, including the 4-years PhD period)
- Author or co-author of ~470 publications in peer-reviewed scientific journals, which have attracted more than 22,000 citations (Web of Knowledge analysis, December 27 2017).
- Author/co-author of high-impact multidisciplinary and chemistry articles: *Nature* (# = 1 + 1 News & Views), *Nature Materials* (# = 1 + 1 News & Views), *Nature Nanotechnology* (# = 1), *Nature Chemistry* (# = 2 + 2 News & Views), *Nature Catalysis* (# = 1 + 1 in press; + 1 News & Views in press), *Nature Communications* (# = 4), *Science Advances* (# = 1), *Chemical Reviews* (# = 3), *Chemical Society Reviews* (# = 6), *Accounts of Chemical Research* (# = 1), *Journal of the American Chemical Society* (# = 29), *Angewandte Chemie-International Edition* (# = 47), *Chemical Science* (# = 1) and *Chemical Communication*s (# = 18).
- Author/co-author of articles/chapters in proceedings (# = 21), other journals (# = 17) and books (# = 27).
- Guest editor of themed scientific journal issues: *Physical Chemistry and Chemical Physics* (# = 3), *Catalysis Today* (# = 1), *ChemSusChem* (# = 1), *Topics in Catalysis* (1), *Topics in Organometallic Chemistry* (# = 1), *Green Chemistry* (# = 2) and *Chemical Society Reviews* (# = 2).
- Editor or co-editor of three scientific books.

C. Research Topics

The Weckhuysen group has been active for many years in the design, synthesis, characterization and application of catalytic solids for the conversion of fossil (crude oil & natural gas) and renewable (biomass) feedstock into transportation fuels, chemicals and

materials. More recently, research is devoted to the catalytic activation of CO_2 and the splitting of water into hydrogen and oxygen. The group is internationally renowned for the development of in-situ and operando spectroscopy and microscopy for studying catalytic solids under realistic conditions. This approach has provided unique insights in the working and deactivation mechanisms of catalytic processes, as well as in the internal architecture of solid catalysts. The goal is to shed detailed new insight in the working principles of catalytic solids while they really work (i.e. high temperatures and pressures, and real-life conditions) and to achieve this he strives to build a “powerful camera” to chemically image heterogeneous catalysts from the level of the reactor down to the level of single atoms and molecules.

- Development and use of advanced spectroscopic methods applied on heterogeneous catalysts during preparation and real operation in order to develop structure-activity relationships for catalytic processes. Systems of interest are supported metal and metal oxide catalysts, zeolites as well as metal organic frameworks. The main emphasis is on space- and time-resolved UV-Vis, Raman, IR, and fluorescence spectroscopy as well as X-ray absorption spectroscopy and diffraction methods. Catalytic reactions under study are methane and light alkanes activation, Fischer-Tropsch synthesis, fluid catalytic cracking, methanol-to-olefins, automotive catalysis as well as selective oxidation, biomass-derived oxygenates hydrogenation/hydrodeoxygenation and olefin polymerization reactions.
- Catalytic conversion of biomass to transportation fuels and bulk chemicals, more specifically the valorization of polyols, e.g. glycerol and sugars, via telomerization, hydrogenolysis and etherification, valorization of lignin and humins and related model compounds and the conversion of C5- and C6-sugars, including the selective hydrogenation of sugar-derived compounds, such as levulinic acid. This also includes the use of spectroscopy for monitoring biomass conversion processes in the liquid phase (i.e., water at relatively high temperatures and pressures), including issues as catalyst stability.
- Synthesis and characterization of ordered porous materials with catalytic potential. The focus is on the fundamental understanding of assembly processes of porous oxides, the development of spectroscopic tools to evaluate the synthesis parameters and the structural aspects of porous materials, including intergrowth structures, spatiotemporal zoning of elements, such as aluminum, and the processes of dealumination and

desilication. The materials focus is on molecular sieves, including zeolites and metal organic frameworks.

- Molecular design of transition metal ion complexes in inorganic hosts for catalysis and adsorption. Enzymes, the most effective catalysts in nature, are the inspiration source for this research. Catalytic reactions of interest are NO decomposition, methane activation and selective oxidation reactions. More recently this also involves photo-catalytic applications, including solar fuels generation, including the construction of thin films, which could separate and adsorb light molecules, such as CO_2, and activate them with light or renewable electricity, harvested from wind or solar panels.

Enclosures

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1. Publications in International Scientific Journals.
2. Publications in National Scientific Journals.
3. Books and Book chapters.
4. Conference Proceedings.
5. Patents and patent applications.
6. Invited Plenary and Keynote lectures.
7. Invited Lectures at Universities and Chemical Companies.
8. Scientific Awards and Honours.
9. Organization of Conferences and Workshops.
10. Editorial and International Advisory Board of Scientific Journals.
11. Active Participation in National and International Boards.

Enclosure 1: Publications in International Scientific Journals

(Sorted by journal and in reversed chronologic order.)

Nature and Science group Publications

1. C. Vogt, E. Groeneveld, G. Kamsma, M. Nachtegaal, L. Lu, C.J. Kiely, P.H. Berben, F. Meirer, B.M. Weckhuysen, Unraveling structure sensitivity in CO_2 hydrogenation over nickel, *Nature Catalysis* 2018, in press.
2. B.M. Weckhuysen, Solid Catalysts in the Spotlights, *Nature Catalysis* 2018, in press. (News & Views article)
3. A. Dutta Chowdhury, K. Houben, G.T. Whiting, S.H. Chung, M. Baldus, B.M. Weckhuysen, Electrophilic aromatic substitution over zeolites generates Wheland-type reaction intermediates, *Nature Catalysis* 2018, DOI: 10.1038/s41929-017-0002.
4. J.E. Schmidt, R. Oord, W. Guo, J.D. Poplawsky, B.M. Weckhuysen, Nanoscale tomography reveals the deactivation of automotive copper-exchanged zeolite catalysts, *Nature Communications* 2017, 8, 1666.
5. Y. Liu, F. Meirer, C.M. Krest, S. Webb, B.M. Weckhuysen, Relating structure and composition with accessibility of a single catalyst particle using correlative 3-dimensional micro-spectroscopy, *Nature Communications*, 2016, **7**, 12634.
6. B.M. Weckhuysen, Zeolite-encaged silver nanoclusters as highly photoluminescent materials, *Nature Materials*, 2016, **15**, 933. (News & Views article)
7. D.E. Perea, I. Arslan, J. Liu, Z. Ristanovic, L. Kovarik, B.W. Arey, J.A. Lercher, S.R. Bare, B.M. Weckhuysen, Determining the location and nearest neighbours of aluminium in zeolites with atom probe tomography, *Nature Communications* 2015, **6**, 7589.
8. F. Meirer, S. Kalirai, D. Morris, S. Soparawalla, Y. Liu, G. Mesu, J.C. Andrews, B.M. Weckhuysen, Life and death of a single catalytic cracking particle, *Science Advances* 2015, **1**, e1400199.
9. W. Luo, M. Sankar, A.M. Beale, Q. He, C.J. Kiely, P.C.A. Bruijnincx, B.M. Weckhuysen, High performing and stable supported nano-alloys for the catalytic hydrogenation of levulinic acid to gamma-valerolactone, *Nature Communications* 2015, **6**, 6540.
10. P.C.A. Bruijnincx, B.M. Weckhuysen, Biomass conversion: Lignin up for break-down, *Nature Chemistry* 2014, **6**, 1035. (News & Views article)
11. I.L.C. Buurmans, B.M. Weckhuysen, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy, *Nature Chemistry* 2012, **4**, 873.
12. E.M. van Schrojenstein Lantman, T. Deckert-Gaudig, A.J.G. Mank, V. Deckert, B.M. Weckhuysen, Catalytic processes monitored at the nanoscale with tip-enhanced Raman spectroscopy, *Nature Nanotechnology* 2012, **7**, 583.
13. I.L.C. Buurmans, J. Ruiz-Martinez, W.V. Knowles, D. van der Beek, J.A. Bergwerff, E.T.C. Vogt, B.M. Weckhuysen, Catalytic activity in individual cracking catalyst particles imaged throughout different life stages by selective staining, *Nature Chemistry* 2011, **3**, 862.

14. L. Karwacki, M.H.F. Kox, D.A.M. de Winter, M.R. Drury, J.D. Meeldijk, E. Stavitski, W. Schmidt, M. Mertens, P. Cubillas, N. John, A. Chan, N. Kahn, S.R. Bare, M. Anderson, J. Kornatowski, B.M. Weckhuysen, Morphology-dependent zeolite intergrowth structures leading to distinct internal and outer-surface molecular diffusion barriers, *Nature Materials* 2009, **8**, 959.
15. B.M. Weckhuysen, Heterogeneous Catalysis: Catch me if you can!, *Nature Chemistry* 2009, **1**, 690. (News & Views article)
16. E. de Smit, I. Swart, J.F. Creemer, G.H. Hoveling, M.K. Gilles, T. Tylisczak, P.J. Kooyman, H.W. Zandbergen, C. Morin, B.M. Weckhuysen, F.M.F. de Groot, Nanoscale chemical imaging of a working catalyst by scanning transmission X-ray microscopy. *Nature* 2008, **456**, 222.
17. B.M. Weckhuysen. Catalysts live and up close. *Nature* 2006, **439**, 548. (News & Views article)

Chemical Reviews

1. J.J.H.B. Sattler, J. Ruiz-Martinez, E. Santillan-Jimenez, B.M. Weckhuysen, Catalytic dehydrogenation of light alkanes on metal and metal oxides, *Chem. Rev.* 2014, **114**, 10613.
2. J. Zakzeski, P.C.A. Bruijnincx, A.L. Jongerius, B.M. Weckhuysen, The catalytic valorization of lignin for the production of renewable chemicals, *Chem. Rev.* 2010, **110**, 3552.
3. B.M. Weckhuysen, I.E. Wachs, R.A. Schoonheydt. Surface chemistry and spectroscopy of chromium in inorganic oxides. *Chem. Rev.* 1996, **96**, 3327.

Chemical Society Reviews

1. H.E. van der Bij, B.M. Weckhuysen, Phosporus promotion and poisoning in zeolite-based materials: Synthesis, characterization and catalysis, *Chem. Soc. Rev.* 2015, **44**, 7406.
2. E.T.C. Vogt, B.M. Weckhuysen, Fluid catalytic cracking: recent developments on the grand old lady of zeolite catalysis, *Chem. Soc. Rev.* 2015, **44**, 7342.
3. E. Stavitski, B.M. Weckhuysen, Infrared and Raman imaging of heterogeneous catalysts, *Chem. Soc. Rev.* 2010, **39**, 4615.
4. A.M. Beale, S.M.D. Jacques, B.M. Weckhuysen, Chemical imaging of catalytic solids with synchrotron radiation, *Chem. Soc. Rev.* 2010, **39**, 4656.
5. M.G. O'Brien, A.M. Beale, B.M. Weckhuysen, The role of synchrotron radiation in examining the self-assembly of crystalline nanoporous framework materials: From zeolites and microporous aluminophosphates to metal organic hybrids, *Chem. Soc. Rev.* 2010, **39**, 4767.
6. E. De Smit, B.M. Weckhuysen, The renaissance of iron-based Fischer-Tropsch synthesis: On the multifaceted behavior of catalyst deactivation behaviour. *Chem. Soc. Rev.* 2008, **37**, 2758.

Accounts of Chemical Research

1. L. Espinosa Alonso, A.M. Beale, B.M. Weckhuysen, Profiling physicochemical changes within catalyst bodies during preparation: New insights from invasive and noninvasive micro spectroscopic studies, *Acc. Chem. Res.* 2010, **43**, 1279.

Angewandte Chemie, International Edition

1. F.C. Hendriks, S. Mohammadian, Z. Ristanovic, S. Kalirai, F. Meirer, E.T.C. Vogt, P.C.A. Bruijnincx, H.C. Gerritsen, B.M. Weckhuysen, Integrated transmission electron and single molecule fluorescence microscopy correlates reactivity with ultrastructure in a single catalyst particle, *Angew. Chem. Int. Ed.* 2018, 57, 257 (Selected by the editorial team as a Very Important Paper and back cover).
2. D. Fu, J.E. Schmidt, Z. Ristanovic, A. Dutta Chowdhury, F. Meirer, B.M. Weckhuysen, Highly oriented growth of catalytically active zeolite ZSM-5 films with a broad range of Si/Al ratios, *Angew. Chem. Int. Ed.* 2017, **56**, 11217.
3. H. Xiong, S. Lin, J. Goetze, P. Pletcher, H. Guo, L. Kovarik, K. Artyushkova, B.M. Weckhuysen, A.K. Datye, Thermally stable and regeneragble Pt-Sn clusters for propane dehydrogenation prepared via atom trapping on ceria, *Angew. Chem. Int. Ed.* 2017, **56**, 8986.
4. J.E. Schmidt, D. Fu, M.W. Deem, B.M. Weckhuysen, Template framework interactions in tetraethylammonium-directed zeolite synthesis, *Angew. Chem. Int. Ed.* 2016, **55**, 16044.
5. A. Dutta Chowdhurry, K. Houben, G.T. Whiting, M. Mokhtar, A.M. Asiri, S.A. Al-Thabaiti, S.N. Basahel, M. Baldus, B.M. Weckhuysen, Initial carbon-carbon bond formation during the early stages of the methanol-to-olefin process proven by zeolite-trapped acetate and methyl acetate, *Angew. Chem. Int. Ed.* 2016, **55**, 15840. (Selected by the editorial team as a Very Important Paper and inner journal cover)
6. J.E. Schmidt, J.D. Poplawsky, B. Mazumder, O. Attila, D. Fu, D.A.M. de Winter, F. Meirer, S.R. Bare, B.M. Weckhuysen, Coke formation in a zeolite crystal during the methanol-to-hydrocarbons reaction as studied with atom probe tomography, *Angew. Chem. Int. Edit.* 2016, **55**, 11173.
7. S. Kalirai, P.P. Palanen, J. Wang, F. Meirer, B.M. Weckhuysen, Visualizing dealumination of a single zeolite domain in a real-Life catalytic cracking particle, *Angew. Chem. Int. Ed.* 2016, **55**, 11134.
8. R. Rinaldi, R. Jastrzebski, M.T. Clough, J. Ralph, M. Kennema, P.C.A. Bruijnincx, B.M. Weckhuysen, Paving the way for lignin valorization: Recent advances in bioengineering, biorefining and catalysis, *Angew. Chem. Int. Ed.* 2016, **55**, 8164.
9. Z. Ristanovic, J.P. Hofmann, M.I. Richard, T. Jiang, G.A. Chahine, T.U. Schülli, F. Meirer, B.M. Weckhuysen, X-ray excited optical fluorescence and diffraction imaging of reactivity and crystallinity in a zeolite crystal: Crystallography and molecular spectroscopy in one, *Angew. Chem. Int. Ed.* 2016, **55**, 7496.
10. I. Lezcano-González, R. Oord, M. Rovezzi, P. Glatzel, S.W. Botchway, B.M. Weckhuysen, A.M. Beale, Molybdenum speciation and its impact on catalytic activity during methane dehydroaromatization in zeolite ZSM-5 revealed by operando X-ray methods, *Angew. Chem. Int. Ed.* 2016, **55**, 5215. (Including inner journal cover)
11. S. Thiyagarajan, H.C. Genuino, J.C. van der Waal, E. de Jong, B.M. Weckhuysen, J. van Haveren, P.C.A. Bruijnincx and D.S. van Es, A facile solid-phase route to renewable aromatic chemicals from biobased

furanics, *Angew. Chem. Int. Ed.* 2016, **55**, 1368.

12. D. Cicmil, J. Meeuwissen, A. Vantomme, J. Wang, I.K. van Ravenhorst, H.E. van der Bij, A. Muñoz-Murillo, B.M. Weckhuysen, Polyethylene with reverse co-monomer incorporation: From an industrial serendipitous discovery to fundamental understanding, *Angew. Chem. Int. Ed.* 2015, **54**, 13073.
13. Z. Ristanović, M.M. Kerssens, A.V. Kubarev, F.C. Hendriks, P. Dedecker, J. Hofkens, M.B.J. Roeffaers, B.M. Weckhuysen, High-Resolution Single-molecule fluorescence imaging of zeolite aggregates within real-life fluid catalytic cracking particles, *Angew. Chem. Int. Ed.* 2015, **54**, 1836.
14. M. Ruitenbeek, B.M. Weckhuysen, A radical twist to the versatile behavior of iron in selective methane activation, *Angew. Chem. Int. Ed.* 2014, **53**, 11137.
15. J.J.H.B. Sattler, I.D. Gonzalez-Jimenez, L. Luo, B.A. Stears, A. Malek, D.G. Barton, B.A. Kilos, M.P. Kaminsky, T.W.G.M. Verhoeven, E.J.Koers, M.Baldus, B.M. Weckhuysen, Platinum-promoted Ga/Al_2O_3 as highly active, selective, and stable catalyst for the dehydrogenation of propane, *Angew. Chem. Int. Ed.* 2014, **53**, 9251.
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17. Z. Ristanovic, J.P. Hofmann, U. Deka, T.U. Schulli, M. Rohnke, A.M. Beale, B.M. Weckhuysen, Intergrowth structure and aluminium zoning of a zeolite ZSM-5 crystal as resolved by synchrotron-based micro X-ray diffraction imaging, *Angew. Chem. Int. Ed.* 2013, **52**, 13382.
18. P.C.A. Bruijnincx, B.M. Weckhuysen, Shale gas revolution: An opportunity for the production of biobased chemicals?, *Angew. Chem. Int. Ed.* 2013, **52**, 11980.
19. J. Ruiz-Martínez, A.M. Beale, U. Deka, M.G. O'Brien, P.D. Quinn, J.F.W. Mosselmans, B.M. Weckhuysen, Correlating metal poisoning with zeolite deactivation in an individual catalyst particle by chemical and phase sensitive X-ray microscopy, *Angew. Chem. Int. Ed.* 2013, **52**, 5983.
20. I. Gonzalez-Jimenez, K. Cats, T. Davidian, M. Ruitenbeek, F. Meirer, Y. Liu, J. Nelson, J.C. Andrews, P. Pianetta, F.M.F. de Groot and B.M. Weckhuysen, Hard X-Ray nanotomography of catalytic solids at work, *Angew. Chem. Int. Ed.* 2012, **51**, 11986.
21. L.R. Aramburo, E. de Smit, B. Arstad, M.M. van Schooneveld, L. Sommer, A. Juhin, T. Yokosawa, H.W. Zandbergen, U. Olsbye, F.M.F. de Groot, B.M. Weckhuysen, X-ray imaging of zeolite particles at the nanoscale: Influence of steaming on the state of aluminum and the methanol-to-olefin reaction, *Angew. Chem. Int. Ed.* 2012, **51**, 3616.
22. M.A. Karreman, I.L.C. Buurmans, J.W. Geus, A.V. Agronskaia, J. Ruiz-Martinez, H.C. Gerritsen, B.M. Weckhuysen, Integrated laser and electron microscopy correlates structure of fluid catalytic cracking particles to Bronsted acidity, *Angew. Chem. Int. Ed.* 2012, **51**, 1428.
23. K.F. Domke, J.P.R. Day, G. Rago, T.A. Riemer, M.H.F. Kox, B.M. Weckhuysen, M. Bonn, Host-guest geometry in pores of zeolite ZSM-5 partially resolved with multiplex CARS spectromicroscopy, *Angew. Chem. Int. Ed.* 2012, **51**, 1343. (Including inner journal cover)
24. M.W. Zandbergen, S.D.M. Jacques, B.M. Weckhuysen, A.M. Beale, Chemical probing within catalyst

bodies by diagonal offset Raman spectroscopy, *Angew. Chem. Int. Ed.* 2012, **51**, 957.

25. S.D.M. Jacques, M. Di Michiel, A.M. Beale, T. Sochi, M.G. O'Brien, L. Espinosa-Alonso, B.M. Weckhuysen, P. Barnes, Dynamic X-ray diffraction computed tomography reveals real-time insight into catalyst active phase evolution, *Angew. Chem. Int. Ed.* 2011, **50**, 10148. (Including inner journal cover).
26. E. de Smit, M.M. van Schooneveld, F. Cinquini, H. Bluhm, P. Sautet, F.M.F. de Groot, B.M. Weckhuysen, On the surface chemistry of iron oxides in reactive gas atmospheres, *Angew. Chem. Int. Ed.* 2011, **50**, 1584.
27. L. Karwacki, D.A. Matthijs de Winter, L.R. Aramburo, M.N. Lebbink, J.A. Post, M.R. Drury, B.M. Weckhuysen, Architecture dependent distribution of mesopores in steamed zeolite crystals as visualized by FIB-SEM Tomography, *Angew. Chem. Int. Ed.* 2011, **50**, 1294.
28. L. Karwacki, H.E. van der Bij, J. Kornatowski, P. Cubillas, M.R. Drury, D.A.M. de Winter, M.W. Anderson, B.M. Weckhuysen, Unified internal architecture and surface barriers for molecular diffusion of microporous crystalline aluminophosphates, *Angew. Chem. Int. Ed.* 2010, **49**, 6790.
29. P.J.C. Hausoul, A.N. Parvulescu, M. Lutz, A.L. Spek, P.C.A. Bruijinincx, B.M. Weckhuysen, R.J.M. Klein Gebbink, Unprecedented access to key reactive intermediates in the Pd/PR_3-catalyzed telomerization of 1,3-butadiene, *Angew. Chem. Int. Ed.* 2010, **49**, 7972.
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32. E. de Smit, I. Swart, J.F. Creemer, C. Karunkaran, D. Bertwistle, H.W. Zandbergen, F.M.F. de Groot, B.M. Weckhuysen, Nanoscale chemical imaging of the reduction behavior of a single catalyst particle, *Angew. Chem. Int. Ed.* 2009, **48**, 3632. (Including front journal cover).
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36. A.M. Beale, S.D.M. Jacques, J.A. Bergwerff, P. Barnes, B.M. Weckhuysen, Tomographic energy dispersive diffraction imaging as a tool to profile in three dimensions the distribution and composition of metal oxide species in catalyst bodies, *Angew. Chem. Int. Ed.* 2007, **46**, 8832. (Selected by the editorial

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Enclosure 4: Conference Proceedings

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2. B. Weckhuysen, L. Vriens, H. Verachtert. Elimination of butanal from odorous air by a labscale biofilter. *Proc. Environm. Platform,* 1991, 215.
3. B.M. Weckhuysen, R.A. Schoonheydt. Chemistry and spectroscopy of chromium in zeolites. *Stud. Surf. Sci. Catal.* 1994, **84**, 895.
4. B.M. Weckhuysen, I.E. Wachs, R.A. Schoonheydt. Spectroscopic characterization of supported Cr and Cr,Ti catalysts: interaction with probe molecules. *Stud. Surf. Sci. Catal.* 1995, **91**, 151.
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12. B.M. Weckhuysen, D. Baetens, R.A. Schoonheydt. Spectroscopy of the formation of microporous transition-metal ion containing aluminophosphates under hydrothermal conditions. *Stud. Surf. Sci. Catal.* 2001, **135**, 336.
13. W. Fan, R.A. Schoonheydt, B.M. Weckhuysen. How to increase the amount of framework Co^{2+} in microporous crystalline aluminophosphates? *Stud. Surf. Sci. Catal.* 2001, **135**, 337.

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21. J.A. Bergwerff, L.G.A. van de Water, A.A. Lysova, I.V. Koptyug, T. Visser, K.P. de Jong, B.M. Weckhuysen. Monitoring the preparation of (Co)Mo/Al_2O_3 extrudates using spatially resolved spectroscopic techniques. *Stud. Surf. Sci. Catal.* 2006, **162**, 175.

Enclosure 5: Patents and Patent Applications

1. Catalytic destruction of halogenated hydrocarbons. Inventors: B.M. Weckhuysen, R.A. Schoonheydt & P. Van der Avert. WO 2003/057318 A1 patent application by KULeuven and Utrecht University (2003).
2. Heterogeneous chromium catalysts. Inventors: C. Nenu, P. Bodart & B.M. Weckhuysen. WO 2005/082815 A1 Patent Application and EP 1 564 198 A1 Application by Total (2005).
3. Process for the conversion of glycerol and catalytically active material suitable therefore. A. Ruppert & B.M. Weckhuysen, PCT patent application filed by ACTS-ASPECT (2007).
4. Metathesis of chlorinated waste compounds. Inventors: A.W.A.M. van der Heijden, J.H. Bitter & B.M. Weckhuysen. PCT patent application by Universiteit Utrecht Holding B.V. (2007).
5. Method for predicting a physical property of a residue obtainable from a crude oil. Inventors: P. de Peinder, F. Singelenberg, T. Visser and B. Weckhuysen. WO 2008/135411 A1 patent application by Shell (2008).
6. Catalyst for Glycerol Aqueous Phase Reforming and Preparation Thereof. Inventors: Y.M. Chung, T. J. Kim, S.-H. Oh, D. Ayse Boga, P.C.A. Bruijnincx, B.M. Weckhuysen. 10-2010-0056026 Korea patent application by SK Energy (2010); Catalyst for aqueous phase reforming of biomass-derived polyols and preparation method thereof. Inventors: Y.M. Chung, T. Kim, S.H. Oh, D.A. Boga, P.C.A. Bruijninincx, B.M. Weckhuysen, WO 2011/158988 A1 PCT patent application and US 2013/0143733 US Patent application by SK Energy (2011 resp. 2013).
7. Process for the liquid-phase reforming of lignin to aromatic chemicals and hydrogen. Inventors: J. Zakzeski, P.C.A. Bruijnincx, B.M. Weckhuysen, PCT patent application by Universiteit Utrecht Holding B.V. (2011).
8. Supported monometallic and bimetallic catalysts for the hydrogenation of levulinic acid. Inventors: W. Luo, M. Sankar, P.C.A. Bruijnincx, B.M. Weckhuysen. PCT patent application by Utrecht University in the frame of the CatchBio program with support from BASF and DSM (2013).
9. Preparation of polyglycerols. Inventors: F. Kirby, P.C.A. Bruijnincx, B.M. Weckhuysen, PCT patent application by Clariant International Ltd. and Universiteit Utrecht Holding B.V. (2014).
10. Method for preparing a chemical compound using a ruthenium metal catalyst on a zirconium oxide support in the presence of a contaminant. Inventors: J. Ftouni, P.C.A. Bruijnincx, B.M. Weckhuysen, PCT patent application by Utrecht University in the frame of the CatchBio program with support from BASF (2015).

Enclosure 6: Invited Plenary and Keynote Lectures

1. Diffuse reflectance spectroscopy of supported metal-oxide catalysts. New applications of spectroscopy in catalysis. Spring American Chemical Society Meeting, Dallas (Texas, U.S.A.), 29.03-02.04.98 (key-note lecture).
2. Characterization of Alkane Dehydrogenation Catalysts, 2nd Leuven School on Catalysis, Bruges (Belgium), 06.12-09.12.98. (key-note lecture).
3. Rationalizing zeolite synthesis via experimental design and in situ spectroscopy, Meeting of the Dutch Zeolite Association, Leuven (Belgium), 18.12.98 (plenary lecture).
4. Diffuse reflectance spectroscopy in the UV-Vis-NIR region: *in situ* characterization of transition metal ions on surfaces, Workshop "Spectroscopy of transition metal ions on surfaces and defect sites in solids", Nieuwpoort (Belgium), 21.03-23.03.99. (key-note lecture).
5. Snapshots of a heterogeneous catalyst: possibilities and limitations. 5th European Congress on Catalysis, Limerick (Ireland), 02.09.-07.09.01 (key-note lecture).
6. Spectroscopy for the advancement of heterogeneous catalysis, Spring Symposium of the New York Catalysis Society, New York, U.S.A., 17.03-22.03.01 (key-note lecture).
7. Surface chemistry, spectroscopy and the role of vanadium in heterogeneous catalysis, 4th International Symposium on Group V Elements, Toledo (Spain), 09.04-12.04.02 (key-note lecture).
8. Snapshots of a working catalyst: probing catalytic solids with in situ spectroscopy, Annual Norwegian Catalysis Society Meeting, Hafjell (Norway), 28.11-29.11.02. (key-note lecture).
9. Coordination chemistry and in-situ spectroscopy of transition metal ions in zeolites, 15th German Zeolite Meeting, Kaiserslautern (Germany), 05.03-07.03-03. (plenary lecture).
10. NanoCat Summer School "Highlights in nano-scale catalyt design and engineering" – International Summer School on Molecular and Supramolecular Approach to Nano-Designed Catalysts, Turin (Italy), 14.09-20.09.03. (plenary lecture).
11. Chemistry, spectroscopy and the role of supported vanadium oxides in heterogeneous catalysis. Annual Meeting of German Science on Vanadium Oxides, Schmockwitz (Germany), 09.10.-10.10.03. (plenary lecture).
12. Optical characterization techniques. Euroconference on Guest-Functionalized Molecular Sieve Systems, Hattingen (Germany), 20.03-25.03.04. (plenary lecture).
13. Probing catalytic solids with operando spectroscopy: a multi-technique approach. Post 13th International Catalysis Conference Summer School, Caen (France), 18.07-21.07.04. (plenary lecture).
14. Catalysts in action: the power of operando spectroscopy. 3rd European School on Catalysis, Ustron (Poland), 22.09-26.09.04. (plenary lecture).
15. Breaking and making of molecules: catalytic solids in action. Chech Annual Symposium on Catalysis, Prague (Chech Republic), 08.11-09.11.04. (plenary lecture).

16. UV-Vis microspectrometry: probing the initial stages of supported metal oxide catalyst preparation. First Conference of the European Union Coordination Action "CO-ordination of Nanostructured Catalytic Oxides Research and Development in Europe" (CONCORDE), Louvain-la-Neuve (Belgium), 26.01-28.01.05. (key-note lecture).
17. In-situ characterization of oxides. 2nd CONCORDE Workshop "In situ characterisation and modelling of oxide catalysts", Belfast (Northern Ireland), 18.02-19.02.05. (plenary lecture).
18. Host-guest chemistry of Fe-, Cu- and Co-ions in molecular sieves. International workshop on microporous and mesoporous materals as catalytic hosts for Fe, Co and Cu, Scheveningen (The Netherlands). 01.03-04.03.05. (plenary lecture).
19. Operando spectroscopy in heterogeneous catalysis: possibilities, challenges and limitations. Flanders catalysis contact forum "The Active site, from catalyst to reactor", Brussels (Belgium), 19.05-20.05.05 (plenary lecture).
20. Snapshots of catalysts at work: probing heterogeneous catalysts with spectroscopy and microscopy. Royal Society of Chemistry SURCAT Meeting "Novel Surfaces, New catalytic Chemistry", Aberdeen (United Kingdom), 13.07-15.07.05. (plenary lecture).
21. Oxidation catalysts caught in the act: the power of in-situ spectroscopy. 5th World Congress on Oxidation Catalysis, Sapporo (Japan), 25.09.-30.09.05. (key-note lecture).
22. Probing catalysts at work: the power of in-situ spectroscopy and microscopy. Workshop "New methods for the investigation of catalytic reaction mechanisms – kinetics and operando spectroscopy", Berlin (Germany), 27.10.-28.10.05. (plenary lecture).
23. Spectroscopy of metal oxide-based catalysis: An emerging playing field for both experimentalists and theoreticians. International symposium "Catalysis on oxide-type materials: theory and experiment, share needs and capabilities", Krakow (Poland), 17.11-19.11.05. (key-note lecture).
24. In-situ spectroscopy of catalytic oxides. 2nd Conference of the European Union Coordination Action "CO-ordination of Nanostructured Catalytic Oxides Research and Development in Europe" (CONCORDE), Thessaloniki (Greece), 26.01-28.01.06. (plenary lecture).
25. Chicago Catalysis Club lecture. Catalysts live and up close: spectroscopy of catalytic solids at work. Chicago (IL, USA), 13.02.06. (invited lecture).
26. Catalysts live and up close. 38th Polish Congress on Catalysis, Krakow (Poland), 15.03-18.03.06 (plenary lecture).
27. Catalysts live and up close. 2nd International congress on Operando spectroscopy: Fundamental and technical aspects of spectroscopy of catalysts under working conditions, Toledo (Spain), 23.04.-27.04.06. (plenary lecture).
28. Passie voor Licht en Katalysatoren. Happening 50 jaar Chemie bij NWO, Bussum (Netherlands), 08.06.06. (invited lecture).
29. Catalysts live and up close: In-situ spectroscopy of Catalytic Solids. Gordon Conference on Catalysis, New Hampshire (USA), 25.06.-30.06.05. (invited lecture).

30. Host-guest chemistry of zeolite-encaged metal ion complexes. Pannonian Congress on Catalysis, Szeged (Hungary), 04.07-07.07.06. (plenary lecture).
31. Spectroscopy for probing catalyst preparation processes. International Congress on Preparation of Catalysts, Louvain-la-Neuve (Belgium), 10.09.-13.09.06-. (key-note lecture).
32. Catalyst locomotion: Probing catalytic solids with in-situ spectroscopy and microscopy. 2nd Chinese-Dutch Annual Catalysis Workshop " Chemistry and catalytic reactivity of small transition metal oxide clusters occluded in micro- and mesoporous materials. Maastricht, the Netherlands, 18.10-21.10.06 (invited lecture).
33. Katalyse op moderne wijze onderzocht. Koninklijke Maatschappij voor Natuurkunde "Diligentia", The Hague, the Netherlands, 30.10.06 (invited lecture).
34. Catalysts live and up close: Probing catalytic solids with spectroscopy and microscopy. 10th International European Science and Engineering Symposium "Advanced Materials", Machelen, Belgium, 29.11-30.11.06. (plenary lecture).
35. Towards catalyst diagnostics with in-situ spectroscopy: prototype development and implementation in industrial pilot-scale reactors. ACTS means Business: Converting excellent knowledge into business potential. Eindhoven, The Netherlands, 06.12.06. (invited lecture).
36. Catalyst locomotion: Towards understanding heterogeneous catalysts making use of in-situ spectroscopy. Gordon Conference on the Chemistry of Hydrocarbon Resources, California, USA, 07.01-12.01-07 (invited lecture).
37. Heterogeneous catalysis and in-situ spectroscopy: Endeavours in understanding catalytic phenomena. NCCC-VIII, Noordwijkerhout, the Netherlands, 05.03-07.03.07 (key-note lecture).
38. Zeolites: From boiling stones to smart crystals. PAC Symposium "Boiling Points", Utrecht, the Netherlands, 01.03.07 (plenary lecture).
39. Catalysts live and up close: Probing catalytic solids at work. First IDECAT Conference on Catalysis, Porquerolles (France), 12.05-17.05.2007 (invited lecture).
40. Catalysts live and up close: Probing catalytic solids at work. First International School on Applied Catalysis and IX Italian Seminar on Catalysis 2007, Bari (Italy), 03.06-09.06-07 (invited lecture).
41. Catalysts live and up close: In-situ micro-spectroscopic studies of single zeolite crystals in the act. 3rd International Conference on Catalysis: fundamentals and application, Novosibirsk, Russia, 04.07-08.07.07 (key-note lecture).
42. Catalytic solids at the end of their lifespan: How can we characterize aging catalysts? ExxonMobil Conference on Catalyst Deactivation, Hershey (PA, USA), 16.10.07 (invited lecture).
43. In-situ spectroscopy and catalytic solids: what can we learn about reaction and deactivation mechanisms? Catalysis Society of Metropolitan New York Lecture, New York (NY, USA), 17.10.07 (invited lecture).
44. Vizualizing catalysts at work, Het Element, Delft (The Netherlands), 08.11.07 (plenary lecture).
45. In-situ spectroscopy of catalytic solids with synchrotron radiation, Workshop 'In situ and time reolved studies of catalysts and catalytic processes', ESRF, Grenoble, France, 06.02-07.02.08 (invited lecture).

46. Space and time resolved in-situ spectroscopy of catalytic solids in the act, ACS Symposium in honour of the G. Olah Award for Israel E. Wachs, New Orleans (LA, USA), 06.04-07.04.08 (invited lecture).
47. Space and time resolved in-situ spectroscopy of catalytic solids in the act. International Conference 'Catalysis for Society', Krakow, Poland, 11.05-15.05.08 (plenary lecture).
48. Chemocatalytic conversion of biomass, 4th International Conference on Renewable Resources and Biorefineries, Rotterdam, the Netherlands, 01.06-04.06.08 (invited lecture).
49. In situ spectroscopy of zeolites in the act. Gordon Conference on Nanoporous materials, Waterville (MA, USA), 15.07-20.07.08 (invited lecture).
50. Control of catalytic phenomena at the nanoscale. International conference "Nanocatalysis: Fundamental & Applications", Pre-conference to the International Congress on Catalysis, Dalian (China), 09.07-12.07.08 (key-note lecture).
51. Single site heterogeneous catalysts: Design, characterization and catalysis. Creation and Control of Advanced Selective Catalysis, Pre-conference to the International Congress on Catalysis and celebration of the 50th anniversary of the Catalysis Society of Japan, Kyoto (Japan) 09.07-11.07.08 (invited lecture).
52. Catalyst Locomotion: Probing catalytic solids at work with in-situ spectroscopy and microscopy, International Congress on Catalysis, Seoul (Korea), 13.07-18.07.08 (invited lecture).
53. In-situ spectroscopy of catalytic solids, Workshop 'Grand challenges of electron chemistry and catalysis at interfaces', University of California, Santa Barbara (CA, USA), 11.08-15.08.08 (plenary lecture)
54. In-situ microspectroscopy of molecular sieves: elucidating pore size effects and reaction mechanism. 4th International FEZA Conference "Zeolites and related materials: trends, targets and challenges", Paris (France), 02.09-06.09.08 (plenary lecture).
55. De wondere wereld van de katalyse: Op weg naar een duurzame samenleving. Woudschotenconferentie voor docenten Chemie, Zeist (The Netherlands), 07.11-08.11.08 (keynote lecture).
56. Catalyst imaging by STXM and optical micro-spectroscopy, North American Congress on Catalysis, San Francisco (CA, USA), 07.06-12.06.09 (keynote lecture).
57. Catalysts in the act, European Congress on Catalysis, Salamanca (Spain), 30.08-04.09.09 (keynote lecture).
58. Space resolved spectroscopy of acidity in molecular sieves, Zeolites and Molecular Sieves Congress, ZMPC 2009, Tokyo (Japan), 03.08-07.08.09 (keynote lecture).
59. Shedding physicochemical insights in catalyst deactivation phenomena with in-situ micro-spectroscopy. International Symposium on Catalyst Deactivation, Delft (The Netherlands), 25.10-28.10.09 (plenary lecture).
60. Combining microscopy and spectroscopy to shed new insight in heterogeneous catalysts. Catalysis Society of South Africa Conference, Worcester (South Africa), 08.11-11.11.09 (plenary and opening lecture).
61. Microscopy and nanoscopy of catalytic solids at work, Materials Research Society symposium, San Francisco (CA, USA), 05.04-09-04.10 (keynote lecture).

62. Catalytic solids at work: The power of synchrotron-based in-situ spectroscopy, NSLS User Meeting, Brookhaven (NY, USA), 24.05.10 (opening key-note lecture)
63. Playing the catalysis murder mystery game: Whodunit?, International Congress on Progress in Fundamental and Applied Catalysis, Dalian, China, 03.06-06.06.10 (key-note lecture)
64. In-situ Micro- and Nanospectroscopy of Zeolites: Reactivity, Acidity, Diffusion Barriers and Dealumination, Les Sciences de la Catalyse a l'Aube du 21eme siecle, Lyon (France), 22.11-23.11.10 (opening key-note lecture).
65. The catalytic valorization of lignin for the production of renewable chemicals, International Symposium on Biomass Conversion: Fundamentals & Applications, Miyazaki (Japan), 01.12-02.12.10 (key-note lecture)
66. Iron-based Fischer-Tropsch Synthesis: new insights from In-situ spectroscopy, diffraction and theory, Royal Society of Chemistry SurCat Symposium, London (UK), 13.12.10 (plenary lecture)
67. The Magic of Catalysis: Water 2 Wine, Utrecht (The Netherlands), Lecture of the 375th Dies Natalis of Utrecht University, 25.03.11.
68. Catalysts Live and Up Close: Insights from In-situ Micro- and Nano-Spectroscopy Studies, North American Congress on Catalysis, Detroit (MI, USA), 05.06-10.06.11 (plenary lecture).
69. In-situ Micro- and Nanospectroscopy of Zeolites: Reactivity, Acidity, Diffusion Barriers and Dealumination, International Symposium of the Federation of European Zeolite Association, Valencia (Spain), 03.07-07.07.11 (key-note lecture).
70. Application of high-energy photons in heterogeneous catalysis research, European Congress on Catalysis, Glasgow (United Kingdom), 31.08-02.09.11 (key-note lecture).
71. Probing Microporous Oxide Formation Processes Using Simultaneous Multiple In-situ Techniques, Chemie schafft Zukunft, German Chemistry Congress, Bremen (Germany), 04.09-07.09.11 (key-note lecture).
72. Micro-spectroscopy of Fischer-Tropsch and Methanol-to-Olefin Catalysts at Work, Cape Town, International Symposium for Syngas Conversion, Cape Town (South Africa), 01.04-04.04.2012 (key-note lecture).
73. Chemical Imaging of Catalytic Solids at the Single Particle Level, 4th International Congress on Operando Spectroscopy, Upton (NY, USA), 29.04-03.05.2012 (plenary lecture).
74. In-situ Spectroscopy of Catalytic Solids: Dynamic Processes at the Individual Particle Level, Gordon Conference on Catalysis, New London (NH, USA), 24.06-29.06.2012 (invited lecture).
75. Catalysts Live and Up Close: Heterogeneities in Space and Time, 15th International Congress on Catalysis, Munich (Germany), 01.07-06.07.2012 (plenary lecture).
76. Chemical Imaging of Individual Catalyst Particles in Space and Time, 14th Netherlands Congress on Catalysis and Chemistry, Noordwijkerhout (The Netherlands), 11.03-13.03.2013 (plenary lecture).
77. Catalytic Conversion of Lignin, Minisymposium on Sustainable Catalysis, University of St. Andrews, St. Andrews (United Kingdom), 24.03.2013-25.03.2013 (plenary lecture).

78. X-ray Microscopy and Tomography of Catalytic Solids at Work, Wilhelm und Else Heraeus-Seminar “Energy-related catalysis today and tomorrow: From fundamentals to applications”, Bad Honnef (Germany), 25.03.2013-28.03.2013 (plenary lecture).
79. Nanoscale imaging of acidity, porosity and reactivity within molecular sieves, International Symposium on Acid-Base Catalysis, Tokyo (Japan), 12.05.2013-15.05.2013 (plenary lecture).
80. Catalytic Valorization of Lignin, International Symposium of Green Chemistry, La Rochelle (France), 21.05.2013-24.05.2013 (plenary lecture).
81. Life and death of a fluid catalytic cracking particle, International Zeolite Conference, Moscow (Russia), 07.07.2013-12.07.2013 (key-note lecture).
82. Surface Enhanced Raman Spectroscopy for Catalysis Research, International Conference on Photochemistry, Leuven (Belgium), 21.07.2013-26.07.2013 (key-note lecture).
83. Nanoscale chemical imaging of catalyst particles at work, International Symposium on the Relationships between Homogeneous and Heterogeneous Catalysis, Sapporro (Japan), 04.08.2013-09.08.2013 (key-note lecture).
84. Chemical Imaging of Spatial Heterogeneities in Catalytic Solids at Different Length and Time Scales, European Congress on Catalysis, Lyon (France), 01.09.2013-06.09.2013 (plenary opening lecture).
85. Catalytic Valorization of Lignin, Norwegian Catalysis Symposium, Trondheim (Norway), 02.12.2013-03-12.2013 (key-note lecture).
86. Towards Solar Light-Induced Vapor Bubble Nanoreactor Catalysis, Physics@FOM 2014, Veldhoven (The Netherlands), 21.01.2014-23.01.2014 (invited focus session lecture).
87. A City that runs on CO_2, TEDx Binnenhof 2014, The Hague (The Netherlands), 31.03.2014 (invited lecture).
88. Niet alles is goud, wat blinkt: Over alchemie, chemie en Katalyse, KNCV Voorjaarbijeenkomst 2014, Bussum (The Netherlands), 08.05.2014 (key-note lecture).
89. Recent Advances in Single Catalyst Particle Spectroscopy, Advanced Porous Materials 2014 Symposium, ETH Zurich (Switzerland), 02.06.2014-03.06.2014 (key-note lecture).
90. In-situ spectroscopic tools for monitoring catalytic biomass transformations, Cascatbel Summerschool, Bysice (Czech Republic), 11.06.2014, (invited lecture).
91. About Apples and Catalyst Particles: New Vistas on the Grand Old Lady of Zeolite Catalysis, 6th International FEZA Conference, Leipzig (Germany), 08.09.2014-11.09.2014 (plenary opening lecture).
92. About Apples and Catalyst Particles: New Vistas on the Grand Old Lady of Zeolite Catalysis, Stanford University, Palo Alto (CA, USA), 15.9.2014-20.9.2014, 2014 Annual Meeting of the Pacific Coast Catalysis Society (key-note lecture).
93. Op weg naar een duurzamere samenleving: Droom wordt werkelijkheid met chemie, Koninklijk Genootschap Physica, Alkmaar (The Netherlands), 03.11.214 (invited lecture).
94. Op weg naar een duurzamere samenleving: Droom wordt werkelijkheid met chemie, Woudschoten Chemie Conferentie, Zeist (The Netherlands), 07.11.2014-08-11.2014 (plenary lecture).

95. How to use nature for our purpose: Catalysis for the producton of biomass-based building blocks, Dutch Catalysis Society Workshop “Catalysis for the Future: Practical Aspects of using Alternative Resources for Fuels and Chemicals”, Amsterdam (The Netherlands), 14.11.2014 (invited lecture).
96. Micro-spectroscopic Characterization of Zeolite-based Catalyst Materials: Life and Death of a Single Catalyst Particle, 1st Winter Conference of the UK Catalysis Hub, Harwell (United Kingdom), 10.12.2014-11-12.2.2014 (plenary lecture).
97. Towards a Circular Economy? - Catalysis for the Production of Biomass-Based Building Blocks, ChemEner2015 Conference, Berlin (Germany), 18.01.2015-21.01.2015 (plenary lecture).
98. Recent Progress in the Characterization of Zeolite-based Catalyst Materials, Euro-Asian Zeolite Conference, Nice (France) 26.01.2015-28.01.2015 (plenary lecture).
99. Towards a Multiscale Science Approach in Heterogeneous Catalysis, Rideal Conference, Berlin (Germany), 25.03.2015-27.03.2015 (invited lecture).
100. Towards a Circular Economy? – Catalysis for the Production of Biomass-Based Building Blocks, EXPO 2015, Milan (Italy), 11.05.2015 (invited lecture).
101. In-situ Spectroscopy of Real Catalysts, SUNCAT Summer School, Stanford University, Stanford (USA), 24.08.2015-28.08.2015 (key-note lecture).
102. Towards a Circular Economy? Catalysis for the Production of Biomass-Based Building Blocks, 2nd EuCheMS Congress on Green and Sustainable Chemistry, Lisbon (Portugal), 04.10.2015-07.10.2015 (plenary lecture).
103. Zeolites studied at the level of single particles, molecules and atoms, 25th Anniversary ITQ, Valencia (Spain), 22.10.2015-23.10.2015 (invited lecture).
104. Catalytic Materials studied at the Level of Single Particles, Molecules and Atoms, XLVIII Polish Annual Conference on Catalysis, Cracow (Poland), 16.03.2016-18.03.2016 (plenary lecture).
105. Photo-spectroscopy of mixtures of catalyst particles reveals their age and type, Faraday Discussions: Designing New Heterogeneous Catalysts, London (UK), 04.04.2016-06.04.2016 (invited lecture).
106. X-ray Micro-Spectroscopy of Hydrodesulfurization Catalysts, 7th International Symposium on Molecular Aspects of Catalysis by Sulfides (MACS-VII), Doorn (The Netherlands), 22.05.2016-26.05.2016 (plenary lecture).
107. Polyethylene with Reverse Co-monomer Incorporation: From an Industrial Serendipitous Discovery to Fundamental Understanding, Blue Sky Conferences on Catalytic Olefin Polymerization, Sorrento (Italy), 27.06.2016-01.07.2016 (key-note lecture).
108. Catalytic solids studied at the level of single particles, molecules and atoms, 16th International Congress on Catalysis, Beijing (China), 03.07.2016-08.07.2016 (invited lecture).
109. Operando spectroscopy and microscopy of Fischer-Tropsch synthesis and methanol-to-olefins catalysts, Post-symposium on Catalysis for Syngas and Methanol Conversion of the 16th International Congress on Catalysis, Beijing (China), 09.07.2016-11.07.2016 (plenary lecture).

110. Operando spectroscopy of a catalytic solid: Towards a molecular movie, 24th Solvay Conference on Chemistry, Catalysis in Chemistry & Biology, Brussels (Belgium), 18.10.2016-22.10.2016 (invited lecture).
111. In-situ and Operando Micro-Spectroscopy of Catalytic Solids, AVS International Symposium, Nashville (TN, USA), 06.11.2016-11.11.2016 (key-note lecture).
112. Advances in Multiscale Spectroscopy of Catalytic Solids at Work, Materials Research Society Meeting, Boston (MA, USA), 27.11.2016-02.12.2016 (key-note lecture).
113. Advances in Operando X-ray Spectroscopy of Solid Catalysts, Spring American Chemical Society Meeting, San Francisco (CA, USA), 02.04.2017-06.04.2017 (invited lecture).
114. Catalysis for Levulinic Acid Hydrogenation: Influence of Catalyst Composition, Syntheiss and Feed Impurities, Spring American Chemical Society Meeting, San Francisco (CA, USA), 02.04.2017-06.04.2017 (invited lecture).
115. Single Molecule Fluorescence of a Single Catalyst Particle, Spring American Chemical Society Meeting, San Francisco (CA, USA), 02.04.2017-06.04.2017 (invited lecture).
116. Advances in Operando Spectroscopy of Solid Catalysts, Spring American Chemical Society Meeting, San Francisco (CA, USA), 02.04.2017-06.04.2017 (invited lecture).
117. Putting Zeolites in the Picture: Recent Advances in Nano-Spectroscopy, 8th Acid-Base Conference, Rio de Janeiro (Brazil), 08.04.2017-10.04.2017 (plenary and opening lecture).
118. Central Science & Grand Challenges: Towards More Chemistry between Scientific Disciplines, HERCuLES symposium of the Academia Europaea "Crossing over to the future: Interdisciplinarity in research and higher education", Stokholm (Sweden), 18.05.2017-20.05.2017 (key-note lecture).
119. Advances in Chemical Imaging of Solid Catalysts at Work, Telluride Symposium “The Theory and Practice of Catalysis”, Telluride (CO, USA), 10.06.2017-14.06.2017 (invited lecture).
120. Advances in Chemical Imaging of Solid Catalysts at Work, “Operando and in situ spectroscopy: advances in the study of functional materials” Symposium of the Spanisch Chemical Royal Society (RSEQ) Meeting, Stiges (Spain), 26.06.2017 (invited lecture).
121. Putting Zeolites in the Picture: Recent Advances in Nano-Spectroscopy, Gordon Research Conference on Nanoporous Materials and Their Applications, Andover (NH, USA), 06.08.2017-11.08.2017 (invited lecture).
122. Putting Solid Catalysts in the Picture: Recent Advances in Nano-Spectroscopy, 19th Brazilian Congress on Catalysis and IX Mercosul Congresson Catalysis, Ouro Preto (Brazil), 17.09.2017-21.09.2017 (plenary and opening lecture).
123. Planet that Runs on CO_2, Workshop to honour the 60th birthday of Jean-Marie Solvay, President of the Solvay Institutes, Brussels (Belgium), 18.10.2017 (invited lecture).
124. Putting Solid Catalysts in the Picture: Recent Advances in Nano-Spectroscopy, 8th Asian-Pacific Chemical Reaction Engineering Symposium, Shanghai (China), 12.11.2017-15.11.2017 (plenary and opening lecture).

Enclosure 7: Invited Lectures at Universities and Chemical Companies

1. *Lehigh University*, Bethlehem (PA, U.S.A.), 14.07.95, Diffuse reflectance spectroscopy of supported transition metal oxide catalysts.
2. *United Catalysts Inc.*, Louisville (KY, U.S.A.), 01.09.95, Surface chemistry of chromium in inorganic oxides.
3. *Lehigh University*, Bethlehem (PA, U.S.A.), 15.09.95, Surface chemistry of chromium in inorganic oxides.
4. *Union Carbide Corp.*, Piscataway (NJ, U.S.A.), 18.09.95, Surface chemistry of chromium in inorganic oxides.
5. *Universität Düsseldorf*, Düsseldorf (Germany), 03.06.96, Zeolite encapsulated transition metal ion complexes as mimics of natural enzymes.
6. *Union Carbide Corp.*, Piscataway (NJ, U.S.A.), 25.07.96, *In situ* spectroscopy of supported chromium oxide catalysts.
7. *United Catalysts Inc.*, Louisville (KY, U.S.A.), 29.07.96, *In situ* spectroscopy of supported chromium oxide catalysts.
8. *Lehigh University*, Bethlehem (PA, U.S.A.), 02.08.96, *In situ* spectroscopy of supported chromium oxide catalysts.
9. *ABB Lummus Corp.*, Bloomfield (NJ, U.S.A.), 07.08.96, Surface chemistry and spectroscopy of chromium in inorganic oxides.
10. *ABB Lummus Corp.*, Bloomfield (NJ, U.S.A.), 06.09.96, Surface chemistry and spectroscopy of Cr/Al_2O_3 catalysts.
11. *Fritz-Haber-Institute of the Max-Planck-Society*, Berlin (Germany), 28.11.97, Chemistry, spectroscopy and chemometrics of supported transition metal ions.
12. *Technische Universiteit Eindhoven*, Eindhoven (The Netherlands), 16.12.97, Chemistry, spectroscopy and chemometrics of supported transition metal ions.
13. *Weizmann Institute of Science*, Rehovot (Israel), 20.2.98, Chemistry, spectroscopy and chemometrics of supported transition metal ions.
14. *Borealis Kallo N.V.*, Antwerp (Belgium), 18.5.98, *In situ* spectroscopy of supported chromium oxide catalysts.
15. *Technische Universiteit Munchen* (Munich, Germany), 17.7.98, Rationalizing heterogeneous catalysis and zeolite synthesis *via* experimental design.
16. *Institute of Physics and Material Science* (Bucharest, Romania), 12.10.98, *In situ* spectroscopy of supported chromium oxide catalysts.
17. *Hokkaido University* (Sapporo, Japan), 10.11.98, Cu(amino acid) complexes on inorganic surfaces : nature as inspiration source for the development of advanced nanomaterials.
18. *Fritz-Haber-Institute of the Max-Planck-Society*, Berlin (Germany), 20.01.99, Rationalising heterogeneous catalysis and zeolite synthesis via experimental design and *in-situ* spectroscopy.
19. *Ruhr-University Bochum*, Bochum (Germany), 26.01.99, Rationalising heterogeneous catalysis and zeolite synthesis via experimental design and *in-situ* spectroscopy. Uitgenodigde lezing in het kader van het Graduiertenkolleg “Dynamische prozesse an Festkorperoberflachen”.

20. *United Catalysts Inc.*, Louisville (KY, U.S.A.), 28.05.99, Supported chromium oxide catalysts and their activity in alkane dehydrogenation reactions.
21. *Helsinki University*, Helsinki (Finland), 24.08.99, Raman spectroscopy of metal oxide catalysts: theory and applications.
22. *Helsinki University of Technology*, Espoo (Finland), 26.08.99, Supported chromium oxide catalysts and their activity in alkane dehydrogenation reactions.
23. *Weizmann Institute of Science*, Rehovot (Israel), 26.11.99, *In situ* Spectroscopy of the Formation of Microporous Transition-metal ion containing Aluminophosphates under Hydrothermal conditions.
24. *Fritz-Haber-Institute of the Max-Planck-Society*, Berlin (Germany), 08.12.99, *In situ* Spectroscopy of the Formation of Microporous Transition-metal ion containing Aluminophosphates under Hydrothermal conditions.
25. *Weizmann Institute of Science*, Rehovot (Israel), 25.01.01, Spectroscopy for the advancement of catalysis.
26. *Akzo Nobel*, Dobbs Ferry (NY, U.S.A.), 20.03.01, *In situ* spectroscopy of catalysts: possibilities and limitations.
27. *ABB Lummus Global*, Bloomfield (NJ, U.S.A.), 22.03.01, Alkane dehydrogenations over supported chromium oxide catalysts.
28. *Haldor Topsoe*, Lyngby (Denmark), 06.04.01, Spectroscopy for the advancement of heterogeneous catalysis.
29. *Thermo-Optek*, Breda (The Netherlands), 24.04.01, Raman spectroscopy: basic principles and applications in the field of heterogeneous catalysis.
30. *Avantium Technologies*, Delft (The Netherlands), 26.04.01, The use of design of experiments and chemometrics in zeolite synthesis and heterogeneous catalysis.
31. *Universiteit Leiden*, Leiden (The Netherlands), 22.10.01, Geometry and framework interactions of zeolite-encapsulated copper(II)-histidine complexes and their activity in oxidation catalysis.
32. *Université de Caen*, Caen (France), 29.11.01, Snapshots of a working catalyst: possibilities and limitations of in situ spectroscopy.
33. *Université de Louvain-la-Neuve* (Belgium), 15.05.02, Snapshots of a working catalyst: possibilities and limitations of in situ spectroscopy.
34. *Sud-Chemie*, Louisville (KY, U.S.A.), 20.09.02, Low temperature destruction of chlorinated hydrocarbons over supported alkaline earth and lanthanide oxides.
35. *DOW Chemicals*, Zurich (Switzerland), 08.10.02, Low temperature destruction of chlorinated hydrocarbons over supported alkaline earth and lanthanide oxides.
36. *Twente University* (The Netherlands), 15.11.02, Low temperature destruction of chlorinated hydrocarbons over supported alkaline earth and lanthanide oxides.
37. *University of Amsterdam* (The Netherlands), 14.01.03, Probing catalytic solids with in situ spectroscopy.
38. *University of Bucharest* (Romenia), 02.05.03, Low-temperature destruction of chlorinated hydrocarbons over supported alkaline earth and lanthanide oxides.
39. *Borealis*, Antwerp (Belgium), 04.07.03, Operando spectroscopy of Cr/Al_2O_3 dehydrogenation catalysts.

40. *University of Amsterdam*, Amsterdam (The Netherlands), 07.01.04, Low-temperature destruction of chlorinated hydrocarbons over lanthanide oxides.
41. *University of Nijmegen*, Nijmegen (The Netherlands), 07.01.04, Low-temperature destruction of chlorinated hydrocarbons over lanthanide oxides.
42. *Johnson Matthey*, Teesside (United Kingdom), 19.01.04, Snapshots of a working catalyst: a multi-technique approach.
43. *University of Leiden*, Leiden (The Netherlands), 10.02.04, Snapshots of a working catalyst: a multi-technique approach.
44. *University of Utrecht*, Utrecht (The Netherlands), 12.02.04, Breaking and Making.
45. *University of Twente*, Utrecht (The Netherlands), 17.02.04, Breaking and Making.
46. *SABIC*, Geleen (The Netherlands), 09.06.04, Snapshots of a working catalyst: a multi-technique approach.
47. *University of Stuttgart*, Stuttgart (Germany), 19.11.04, Promotion effects in heterogeneous catalysis.
48. *Delft University of Technology*, Delft (The Netherlands), 16.12.04, Catalytic solids caught in the act: the power of in-situ spectroscopy.
49. *Toyota,* Toyota (Japan), 26.09.05, Probing catalytic solids with spectroscopy and microscopy.
50. *University of Chicago,* Chicago (IL, U.S.A.), 14.02.06, Catalysts in action: where we have been and where we are going.
51. *DOW Chemicals,* Midland (MI, U.S.A.), 15.02.06, Catalysts live and up close: spectroscopy of catalysts at work.
52. *UOP,* Des Plaines (IL, U.S.A.), 17.02.06, Catalysts in action: where we have been and where we are going.
53. *BASF*, Ludwigshaven (Germany), 20.02.06, Catalysts live and up close: spectroscopy of catalysts at work.
54. *Oslo University* (Norway), 30.03.06, Catalysts live and up close: Probing catalysts at work.
55. *Gent University* (Belgium), 12.05.06, Spectroscopy and its use in heterogeneous catalysis.
56. *Max-Planck Institut fur Kohlenforschung,* Mullheim (Germany), 18.10.06, Catalyst locomotion: Probing catalytic solids with in-situ spectroscopy and microscopy
57. *Gent University (Belgium), 30.03.07,* Zeolites, from boiling stones to catalytic nanomaterials.
58. *University of Amsterdam, Amsterdam Chemisch Dispuut (The Netherlands), 02-04.07,* Let's talk about catalysis.
59. *Voorjaarsbijeenkomst Samenwerkende Bedrijven Eemsdelta, Delfzijl (The Netherlands), 29.05.07,* Van een fossiel-gebaseerde naar biomassa-gebaseerde economie: realiteit of utopie?
60. *ExxonMobil*, Clinton (NJ, USA), 15.10.07, Catalysts live and up close: Probing catalysts at work.
61. *BASF*, Iselin (NJ, USA), 19.10.07, Catalysts live and up close: Probing catalysts at work.
62. *Pacific Northwest National Laboratory*, Richland (WA, USA), 22.10.07, Distinguished Catalyst Researcher Lecture Series, A close-up view of catalytic solids in action.

63. *Institute of Chemistry of Lyon*, Lyon (France), 18.12.07, A Close-Up View of Catalytic Solids in Action.
64. *Radboud University of Nijmegen*, Nijmegen (The Netherlands), 12.02.2008, A Close-Up View of Catalytic Solids in Action.
65. *University of Caen*, Caen (France), 19.02.2008, A Close-Up View of Catalytic Solids in Action.
66. *Utrecht University*, Utrecht (The Netherlands), USS Proton Ouderdag, 08.03.2008, Katalyse voor een duurzame samenleving.
67. *Total*, Feluy (Belgium), 03.07.08, A Close-Up View of Catalytic Solids in Action.
68. *Sumitomo*, Osaka (Japan), 12.07.08, A Close-Up View of Catalytic Solids in Action.
69. *Leuven University*, Leuven (Belgium), 01.10.08, Transition metal ions in porous oxides: Unique catalytic centers.
70. *University of Oslo*, Oslo (Norway), 03.11.08, A Close-Up View of Catalytic Solids in Action.
71. *Free University of Brussels*, Brussels (Belgium), 10.12.08, In-situ spectroscopy and heterogeneous catalysis: Probing catalytic solids at different length scales.
72. *Albemarle Catalysts*, Amersfoort (The Netherlands), 18.12.08, Catalytic solids: The workhorses of the chemical industry.
73. *Haldor Topsoe,* Lyngby (Denmark), 23.02.09, In-situ spectroscopy and heterogeneous catalysis: Probing catalytic solids at different length scales.
74. *Leuven University,* Leuven (Belgium), 02.07.09, In-situ spectroscopy and heterogeneous catalysis: Probing catalytic solids at different length scales.
75. *University of Johannesburg*, Johannesburg (South Africa), 02.11.09, Understanding Catalyst Preparation Processes: New Insights from Space and Time Resolved Spectroscopy.
76. *University of Witwatersrand,* Johannesburg (South Africa), 02.11.09, Understanding Catalyst Preparation Processes: New Insights from Space and Time Resolved Spectroscopy.
77. *SASOL,* Sasolburg (South Africa), 03.11.09, Co- and Fe-based Fischer-Tropsch catalysis: New insights from spectroscopy and microscopy.
78. *SASOL, Sasoburg (South Africa), 03.11.09,* Shedding physicochemical insights in catalyst deactivation phenomena with in-situ micro-spectroscopy.
79. *University of Kwazulu Natal,* Durban (South Africa), 04.11.09, An Eye on the Inside of Zeolite Mateirals: New Insights in Molecular Diffusion Barriers, Mesoporosity and Bronsted Acidity.
80. *University of Cape Town,* Cape Town (South Africa), 05.11.09, Understanding Catalyst Preparation Processes: New Insights from Space and Time Resolved Spectroscopy
81. *University of Stellenbosch,* Stellenbosch (South Africa), 06.11.09, Catalysis for Renewables: Towards a Biomass-based Society.
82. *ExxonMobil*, Machelen (Belgium), 02.12.09, Playing the catalysis murder mystery game: Whodunit?
83. *Technical University of Denmark*, Lyngby (Denmark), 17.12.09, Catalysis for Renewables: Towards a Biomass-based Society.

84. *Energy Centre Netherlands (ECN), Petten (the Netherlands), 10.03.10,* Catalysis for Renewables: Towards a Biomass-based Society.
85. *Stanford University*, Palo Alto (CA, USA), Playing the catalysis murder mystery game: Whodunit?
86. *University of California at Berkeley*, Berkeley (CA, USA), Playing the catalysis murder mystery game: Whodunit?
87. *Rutgers University,* Piscataway (NJ, USA), *25.05.10,* Playing the catalysis murder mystery game: Whodunit?
88. *University of Oslo,* Oslo (Norway), 16.06.10, An Eye on the inside of zeolite materials: New insights in barriers, mesoporosity and Bronsted acidity.
89. *Soleil Synchrotron,* Paris (France), 24.06.10, Catalytic Solids in the Spotlights: Combining synchrotron radiation techniques with optical spectroscopies.
90. *University of Aachen,* Aachen (Germany), 03.02.11, Catalytic Valorization of Biomass for the Production of Renewable Chemicals.
91. *University of Antwerp,* Antwerp (Belgium), 08.02.11, A sustainable world: A dream can become reality with chemistry.
92. *Utrecht University*, Utrecht (The Netherlands), 25.03.11, The Magic of Catalysis: Water 2 Wine, Lecture of the 375th Dies Natalis of Utrecht University.
93. *Dow Chemicals,* Freeport (TX, USA), 14.04.11, Playing the catalysis murder mystery game: Whodunit?
94. *Rice University,* Houston (TX, USA), 15.04.11, In-situ characterization of Fe-based Fischer-Tropsch catalysts.
95. *Chevron*, Richmond (CA, USA), 16.05.11, An eye on the inside of zeolite materials: New insights in barriers, mesoporosity and Bronsted acidity.
96. *Grace Davison*, Colombia (MA, USA), 05.10.11, In situ spectroscopy of catalytic solids at the single particle level.
97. *University of Leuven*, Leuven (Belgium), 18.12.11, A sustainable world: A dream can become reality with chemistry, Christmas lecture.
98. *BASF*, Ludwigshafen (Germany), 08.02.12, In-situ spectroscopy of catalytic solids at the single particle level.
99. *Caen University*, Caen (France), 01.03.2012, Relationships between structures and properties of porous materials.
100. *Akzo Nobel*, Zeist (The Netherlands), 27.03.2012, New developments in green chemistry: Catalytic valorization of biomass.
101. *SLAC National Accelerator Laboratory*, Menlo Park (CA, USA), 23.05.2012, Active sites in catalysis: Catch me if you can!
102. *University of California at Berkeley*, Berkeley (CA, USA), 30.05.2012, In-situ spectroscopy of porous functional materials at the single particle level.

103. *Stanford University*, Palo Alto (CA, USA), 29.06.2012, In-situ spectroscopy of catalytic solids: Dynamic processes at the individual particle level.
104. *Albemarle Catalysts*, Houston (TX, USA), 16.07.2012, Catalysts live and up close: Heterogeneities in space and time.
105. *Haldor Topsoe*, 23.08.2012, Chemical imaging of catalysts with photons.
106. *Stanford University*, Stanford (CA, USA), 28.8.2012, Putting Catalysts in the Picture: In-situ Chemical Imaging at the Nanoscale.
107. *King Abdulaziz University,* Jeddah (Saudi Arabia), 5.11.2012, Catalysts Live and Up Close: Heterogeneities in Space and Time.
108. *Utrecht University*, Utrecht (The Netherlands), 7.1.2013, New Years lecture, Towards a Sustainable Society, Dreams May Come True with Catalysts.
109. *Eindhoven University of Technology,* Eindhoven (The Netherlands), 24.1.2013, Chemical Imaging of Heterogeneities of Individual Catalyst Particles in Space and Time.
110. *University of Oslo*, Oslo (Norway), 7.12.2012, Putting Catalysts in the Picture: In-Situ Chemical Imaging at the Nanoscale.
111. *Michigan Catalysis Society Meeting,* Livonia, Detroit (MI, USA), 6.2.2013, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy.
112. *Dow Chemicals*, Midland (MI, USA), 7.2.2013, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy.
113. *Argonne National Laboratory*, Argonne (IL, USA), 11.2.2013, Chemical Imaging of Spatial Heterogeneities in Catalytic Solids at Different Length and Time Scales.
114. *BP*, Naperville (IL, USA), 12.2.2013, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy.
115. *UOP, Honeywell*, Des Plaines (IL, USA), 13.2.2013, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy.
116. *Northwestern University*, Evanston (IL, USA), Ipatieff Award Lecture, 14.2.2013, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy: Rational catalyst design within reach?
117. *Vrije Universiteit Amsterdam*, Amsterdam (The Netherlands), PAC symposium, 7.3.13, A sustainable world: Dreams can come true with catalysis.
118. *Albemarle Catalysts*, Baton Rouge (LA, USA), 10.04.2013, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy: Rational catalyst design within reach?
119. *National Institute of Chemistry,* Lubljana (Slovenia), 27.05.2013, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy: Rational catalyst design within reach?
120. *Clariant*, Munich (Germany), 08.05.2013, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy: Rational catalyst design within reach?

121. *National Institute of Chemistry,* Ljubljana (Slovenia), 27.05.2013, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy: Rational catalyst design within reach?
122. *Utrecht University*, Utrecht (The Netherlands), 25.10.2013, Van 't Hoff, Ostwald and Arrhenius: Physical Chemistry of Heterogeneous Catalysis.
123. *SABIC*, Geleen (The Netherlands), 06.12.2013, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy.
124. *University of St. Andrews,* St. Andrews (United Kingdom), 24.02.2014, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy.
125. *University College London*, London (United Kingdom), 26.02.2014, Catalyst live and up close: Recent strides in micro- and nanospectroscopy of catalysts at work.
126. *Cardiff University*, Cardiff (United Kingdom), 27.02.2014, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy.
127. *Eindhoven University of Technology,* Eindhoven (The Netherlands), 18.03.2014, Catalytic valorization of lignin.
128. *Shell*, Amsterdam (The Netherlands), Centennial Annual Conference, 26.03.2014-28.03.2014, Chemical imaging of catalytic solids with X-rays.
129. *Clariant*, Frankfurt (Germany), 08.04.2014, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy: Rational catalyst design within reach?
130. *Borregaard*, Sarpsborg (Norway), 06.05.2014, Catalytic valorization of lignin.
131. *Koninklijke VNP - Vereniging van Nederlandse Papier en Kartonfabrieken*, Den Haag (The Netherlands), 25.06.2014, Een grondstof die sectoren verbindt. De veelzijdigheid en potentiele toepassingen van lignine- het belang voor verschillende sectoren.
132. *Stanford University,* Stanford (Palo Alto, CA, USA), 02-07-2014, Catalytic Conversion of Lignin for the Production of Renewable Chemicals.
133. *Radboud University*, Nijmegen (The Netherlands), 28-10-2014, About Apples and Catalyst Particles: New Vistas on the Grand Old Lady of Zeolite Catalysis
134. *Albemarle Catalysts* (Pasadena, TX, USA), 03-12-2014, About Apples and Catalyst Particles: New Vistas on the Grand Old Lady of Zeolite Catalysis.
135. *ExxonMobil* (Clinton, NJ, USA), 04-12-2014, Micro-spectroscopic Characterization of Zeolite-based Catalyst Materials: Life and Death of a Single Catalyst Particle.
136. *Shell Technology Centre Amsterdam* Amsterdam (The Netherlands), 28.04.2015, Towards a Multiscale Science Approach in Heterogeneous Catalysis.
137. *BASF*, Ludwigshafen (Germany), 06.05.2015, Towards a Multiscale Science Approach in Heterogeneous Catalysis.
138. State Key Laboratory of Catalysis, Chinese Academy of Science, Dalian (China), 29.05.2015, Heterogeneities of individual catalyst particles in space and time as monitored by spectroscopy: Rational catalyst design within reach? (80th Lecture of the Catalysis Forum).

139. *Holland Research School of Molecular Chemistry,* Amsterdam (The Netherlands), 05.11.2015, Catalytic Materials studied at the Level of Single Particles, Molecules and Atoms (HRSMC symposium).
140. *University College London*, Research Complex at Harwell, Oxford (UK), 14.12.2015, Catalytic solids studied at the level of single particles, molecules and atoms.
141. *Imperial College London*, London (UK), 07.04.2016, Catalytic Solids studied at the Level of Single Particles, Molecules and Atoms.
142. *National Physical Laboratory*, London (UK), 08.04.2016, Catalytic Solids studied at the Level of Single Particles, Molecules and Atoms.
143. *ECUST,* Shanghai (China), 16.04.2016, Catalytic Materials studied at the Level of Single Particles, Molecules and Atoms.
144. *Solvay,* Shanghai (China), 17.04.2016, Catalytic Materials studied at the Level of Single Particles, Molecules and Atoms.
145. *Sinopec*, Shanghai (China), 17.04.2016, Catalytic Materials studied at the Level of Single Particles, Molecules and Atoms.
146. *Belgian Royal Academy of Sciences of Flanders*, Brussels (Belgium), 07.09.2016, Hoe geven we de eeuwige jeugd aan katalysatoren? & De Chemische Weg naar een CO_2-neutrale Wereld.
147. *Assemblee,* Utrecht (The Netherlands), 05.10.2016, Naar een duurzamere samenleving met chemie.
148. *Oak Ridge National Laboratory*, Knoxville (USA), 11.11.2016, Operando Spectroscopy of a Catalytic Solid: Towards a Molecular Movie.
149. *Massasuchets Institute for Technology*, Boston (USA), 29.11.2016, Operando Spectroscopy of a Catalytic Solid: Towards a Molecular Movie.
150. *Brookhaven National Laboratory*, Brookhaven (USA), 30.11.2016, Operando Spectroscopy of a Catalytic Solid: Towards a Molecular Movie.
151. *Swiss Light Source*, Villigen (Switzerland), 11.04.2017, About Light, Apples and Catalyst Particles: Recent Strides in the Characterization of Solid Catalysts with Synchrotron Radiation.
152. *ExxonMobil*, Machelen (Belgium), 28.06.2017, Putting solid catalysts in the picture: Advances in nano-spectroscopy of catalysts at work.
153. *Shell*, Amsterdam (the Netherlands), 16.08.2017, Putting solid catalysts in the picture: Advances in nano-spectroscopy of catalysts at work.
154. *Leiden University*, Leiden (the Netherlands), 27.10.2017, Putting solid catalysts in the picture: Advances in nano-spectroscopy of catalysts at work.
155. *Shanghai Institute of Organic Chemistry of the Chinese Academy of Sciences*, Shanghai (China), 13.11.2017, Planet that runs on CO_2.
156. *Fudan University*, Shanghai (China), 14.11.2017, Single molecular spectroscopy of a single catalyst particle.
157. *Peking University*, Beijng (China), 15.11.2017, Operando Spectroscopy of a Catalytic Solid: Towards a Molecular Movie.

158. *Institute of Chemistry of the Chinese Academy of Sciences*, Being (China), 15.11.2017, Planet that runs on CO_2.
159. *Peking University*, Beijng (China), 17.11.2017, Putting solid catalysts in the picture: Advances in nano-spectroscopy of catalysts at work (Xing Da Lectureship).
160. *Wageningen University*, Wageningen (the Netherlands), 28.11.2017, Catalysis for the Production of Chemicals and Fuels from Biomass.

Enclosure 8: Scientific Awards and Honours

1. *Water 1991 Research Award* for the best engineering thesis in the field of water treatment and pollution control. Organization: vzw Water, Energie en Leefmilieu (WEL). The award comprises an honorary certificate and a prize of 50,000 BEF.
2. *Exxon-VJC 1994 Lecture Award* for the best oral presentation at the 2th Flemish Jouth Congres of Chemistry (Antwerp (Belgium), 9 march 1994). Organisation: Royal Flemisch Chemical Society (KVCV). The award comprises an honorary certificate and a prize of 5,000 BEF.
3. *The KULeuven Research Council Award 1998* for the best young researcher of the Catholic University of Leuven. Organization: Research Council of Leuven University. The award comprises an honorary certificate and a price of 200,000 BEF.
4. *The EFCATS School Lecturer Award 2004* for the best lecturer of the 3rd EFCATS School on Catalysis, 21.09-26.09.04 (Ustron, Poland). Organisation: The European Federation of Catalysis Societies (EFCATS). The award comprises an honorary certificate.
5. *The KNCV Gold Medal 2006* for the best researcher in the entire field of chemistry in the Netherlands. Organization: Royal Dutch Chemical Society (KNCV). The award comprises a honorary certificate, a gold medal and a unique art object.
6. *The DECHEMA Award 2007* in recognition of excellent contributions to the development of combined in situ spectroscopic methods and their application to industrial catalytic processes. The award comprises an honorary certificate, a gold medal and a prize of 20,000 Euro. Organization: The Max Buchner Research Foundation of the German Organization of Chemical Engineering and Biotechnology.
7. *The CATSA Eminent Visitor Award 2009* for his contributions to catalysis in particular those aimed to characterize catalysts at working conditions. Organization: The Catalysis Society of South Africa (CATSA). The award, given to distinguished researchers in the field of catalysis, consists of a honorary certificate and the opening plenary lecture at the yearly CATSA conference, as well as giving a series of lectures at major South-African universities and institutes involved in catalysis research (i.e., Universities of Cape Town, Stellenbosch, Johannesburg, Witwatersrand and Kwazulu Natal and Sasol).
8. *The Netherlands Catalysis and Chemistry Award 2009*. This 5-yearly award is given for outstanding contributions to the fundamental understanding and use of catalysis in the Netherlands and Belgium in the preceding 10 years. Organization: The Organization of Dutch Catalysis Industries (VIRAN) and the Catalysis Section of the Royal Dutch Chemical Society (KNCV). The award consists of a plaque and a prize of 10,000 Euro.
9. *The 2011 Paul H. Emmett Award in Fundamental Catalysis.* This 2-yearly award is given in recognition for the pioneering development and use of in-situ spectroscopic methods to probe catalytic solids at the micrometer and nanometer scale during their activation and function. Organization: The North American Catalysis Society (NACS). The award consists of a plaque and a prize of 5,000 USD.

10. *The 2012 International Catalysis Award.* This 4-yearly award is given in recognition for the pioneering development and use of in-situ micro- and nano-spectroscopy to probe catalytic solids at work. Organization: International Association of Catalysis Societies (IACS). The award consists of a plaque and a prize of 5,000 Euro.
11. *The 2013 Vladimir N. Ipatieff Lectureship in Catalysis*. This named lectureship, established in 1988 by Northwestern University (USA), aims to enhance the educational experience of graduate students and postdoctoral researchers by sponsoring extended, up to one month, visits by internationally distinguished researchers in catalysis. This recognition consists of a plaque, a prize of 5,000 USD and 5,000 USD for covering travel and housing costs.
12. *The 2013 Bourke Award* for his highly innovative contributions to the understanding of the functioning of catalytic solids using spectroscopic methods. Organization: The Royal Society of Chemistry (RSC). The award consists of £ 2000 and a medal. Also a lectureship is associated with the Award.
13. *The 2013 Spinoza Award* for his inspiring and breakthrough research in the field of catalysis*.* Organization: Netherlands Organization for Scientific Research (NWO). The award consists of a plaque, art object and research grant of 2.5 million euros. The Spinoza Award is the highest scientific award within the Netherlands.
14. *Knight in the Order of the Netherlands Lion (2015).* Highest civil Royal distinction for service to science and society within the Netherlands.
15. *The 2018 Robert B. Anderson Award of the Canadian Catalysis Society.* The award, named after the prominent Canadian catalysis researcher, is awarded every two years and consists of a travel budget of 5000 CDND to give two plenary lectures and an honorarium of 1500 CDND. The award is given for "for his excellent contributions to the fundamental understanding of the functioning of solid catalysts and the related development of advanced microscopy and spectroscopy methods".
16. *The 2017 Tanabe Prize for Acid-Base Catalysis*. The award, named after the prominent Japane scientist Kozo Tanabe, is awarded every 4 years and consists of a plaque, an honorarium of 2000 USD and a travel budget to give a plenary lecture at the 8th International Symposium on Acid-Base Catalysis in Rio de Janeiro. The prize is awarded for "groundbreaking work on chemical imaging of Brønsted acid sites and related catalytic chemistry within zeolite-based materials, a research field that paves the way towards the rational design of new and improved chemical processes."
17. *The 2017 Xing Da Lectureship of Peking University*. The award, worth a honorarium of 5000 USD and a travel budget, is awarded to a distinguished scholar in the field of chemistry and molecular engineering. The lecture entitled "Hunting for the Hidden Chemistry in Solid Catalysts: Towards a Molecular Movie" was given on November 17, and was accompanied by a lecture tour through different academic institutions in Shanghai and Beijing.

Enclosure 9: Organization of Conferences and Workshops

1. Symposium *"Fourth Meeting of the Benelux EPR Society"* (24 Mei 1996, Arenbergkasteel, Heverlee, Belgium) (Chairmen: B. Weckhuysen and R. Schoonheydt).
2. Workshop *"Surface chemistry and spectroscopy of transition metal ions and defect sites in solids, with special emphasis on electron spin resonance"* (21-23 March 1999, Nieuwpoort, Belgium) (Chairmen: B. Weckhuysen, R. Schoonheydt, P. Van Der Voort and E. Vansant).
3. EXAFS-XANES workshop in the frame of the FWO-Wetenschappelijke Onderzoeksgemeenschap "The active site: from catalyst to reactor" (2-4 May 2000, Leuven, Belgium) (Chairman: B. Weckhuysen).
4. American Chemical Society Fall 2000 Symposium *"Metal oxide catalysts: active sites and reaction intermediates"* (20-24 August 2000, Washington, D.C., USA) (Chairmen: B. Weckhuysen, C. Klug and G. Mestl).
5. Operando-I: International Symposium on the Characterization of Catalysts in Action (2-6 March 2003, Lunteren, The Netherlands) (Chairmen: B. Weckhuysen, G. Mestl, E. Gaigneau and M. Banares).
6. Microporous and mesoporous materials as catalytic hosts for Fe, Co and Cu, An international workshop organized by the Dutch-speaking Zeolite Association (1-4 March 2005, Scheveningen, The Netherlands) (Chairmen: F. Kapteijn, B. Weckhuysen, P. Kooyman, E. Hensen and S. van Donk).
7. Operando-II: International Symposium on the Characterization of Catalysts in Action (23-27 April 2006, Toledo, Spain) (Chairmen: M. Banares, F. Thibault-Starzyk, A. Bruckner, E. Gaigneaux and B. Weckhuysen).
8. Onzekerheidssymposium van De Jonge Academie (KNAW) (1 April 2008, Amsterdam, The Netherlands), (Chairmen: M. Van Asselt, E. Dusseldorp, J. Abbring, K. Henrard, B. Penninx, O. Gelderblom, B. Weckhuysen).
9. Operando-III: International Symposium on the Characterization of Catalysts in Action (19-23 April 2009, Rostock-Warnemunde, Germany) (Chairmen: M. Banares, F. Thibault-Starzyk, A. Bruckner, E. Gaigneaux, I.E. Wachs, S. Bare and B. Weckhuysen).
10. KNAW Symposium: Catalysis for the Future (12 November 2013, Amsterdam, the Netherlands) (Chairman: B. Weckhuysen).
11. 17th International Symposium on the Relationships between Homogeneous and Heterogeneous Catalysis (ISHHC-17) (12-15 July 2015, Utrecht, the Netherlands) (Chairmen: B. Weckhuysen, B. Klein Gebbink and P. Bruijnincx).
12. MCEC-KNAW Symposium "Fuelling the Future: How Catalysis may Contribute to a more Sustainable Society" (14 December, Utrecht, the Netherlands, Chairman: B. Weckhuysen).

Enclosure 10: Editorial and International Advisory Board of Scientific Journals

1. *Physical Chemistry Chemical Physics* (2003-to date; chairman of the editorial board 2006-2008)
2. *Applied Catalysis A:General* (2005-2007)
3. *Catalysis Today* (2007-to date)
4. *Topics in Catalysis* (2006-to date)
5. *Catalysis Letters* (2006-to date)
6. *Journal of Nanoscience and Nanotechnology* (2004-to date)
7. *Journal of Applied Chemistry* (2005-to date)
8. *Vibrational Spectroscopy* (2002-2006)
9. *Chemical Society Reviews* (2010-to date)
10. *ChemCatChem* (2009-to date, co-chairman of the editorial board 2009-2016)
11. *ChemPhysChem* (2014-to date)
12. *Faraday Discussions* (2015-to date)
13. *Chem* (2016-to date)
14. *The Journal of Catalysis* (2017-to date)
15. *Angewandte Chemie International Edition* (2018-to date)

Enclosure 11: Active Participation in National and International Boards

Weckhuysen serves on many boards and panels for national and international research. More specifically he is/was:

- Board member of CW-NWO, the main Dutch funding organization (http://www.nwo.nl) (2012-2016).
- 'Chief Science Officer' of Topteam of the Topsector Chemistry, since 2014 (before member Topteam Chemie, 2011-2014), established by the Ministry of Economy, Agriculture and Innovation http://www.top-sectoren.nl/chemie/topteam, member of the Regiegroep Chemie (http://www.regiegroepchemie.nl) (2011-present), chairman of the board of the TopConsortium voor Kennis en Innovatie 'Nieuwe Chemische Innovaties' (2012- present), executive board member of ACTS (http://www.nwo.nl) (2003-2011) and member of the 'Spelregels Commissie NWO' (2013).
- Member of TWINS (Raad voor Technische Wetenschappen, Wiskunde en Informatica, Natuur- en Sterrenkunde en Scheikunde) of the Netherlands Royal Academy of Sciences (KNAW; http://www.knaw.nl) (2013-2016).
- Board member of the European Federation of Catalysis Societies (EFCATS) (2003-present; treasurer, 2011-2017; since 2017, president), the International Association of Catalysis Societies (IACS) (2003-present) and the International Zeolite Association (IZA) (2013-present).
- Board member of the Stichting Hoogewerff-Fonds (2015-present).
- Scientific Advisory Board member of Scientific Advisory Board member of inGAP (http://www.ingap.uio.no) (2008-2015); CASE (http://www.case.dtu.dk) (2009-present); SusChem Nederland (http://www.vnci.nl) (2009-2012); EaStCHEM (http://www.eastchem.ac.uk) (2013-2016), the Chemical Research Center of the Hungarian Academy of Sciences (2009-present), State Key Laboratory of Catalysis (Dalian, China) (2014-onwards), Cardiff Catalysis Institute (Cardiff, UK) (2017-onwards), the Center for Catalysis and Surface Science of Northwestern University in Evanston (USA) (2017-onwards) and the Max Planck Institute for Chemical Energy Conversion in Mulheim/Ruhr (2017-onwards).
- Member of the Solvay Scientific Committee for Chemistry (2017-2022). (vergoedingen ten gunste van de Universiteit Utrecht)
- Titular Member of the Physical and Biophysical Chemistry Division of the International Union of Pure and Applied Chemistry (IUPAC) (2016-2019).
- Member of "HERCulES" (Higher Education, Research and Culture in European Societies) of Academia Europaea (2015-present).